U.S. Environmental Protection Agency
Chesapeake Bay Program Office

Initial Announcement of
EPA-R3CBP-05-04
Task 12 Attachment 1

List of Chesapeake Bay Program Conservation Practices found in Tributary Strategies

Last Updated: August 18, 2005

Conservation Practices

Group 1 - New/Innovative Practices

Agriculture

- Ammonia Capture
  - Bio-filtration-Poultry/Swine
  - Vegetative Filter-Poultry/Swine
  - Manure Additive-Alum
- Horse Paddock Management
- Innovative Cropping System (ICS) Continuous No-Till
- Precision Agriculture
- Precision Feeding – Dairy/Beef
- Mortality Composters (poultry)
- Streambank Protection w/Fencing
- Streambank Restoration, Non-Urban
- Water Control Structure

Urban

- Streambank Restoration, Urban

Forest

- Forest Harvest Operations
- Dirt & Gravel Road, Stormwater Runoff Controls

Group 2 - Current Practices

Agriculture

- Conservation Tillage
- Cover Crops
- Rotational Grazing
- Conservation Planning
- Enhanced Nutrient Management
- Wetland Restoration/Enhancement
- Forest Buffers

Urban

- Wet Ponds & Wetlands
- Dry Detention/Extended Detention Ponds
- Erosion & Sediment Control

Group 1 - New/Innovative Practices

AMMONIA CAPTURE – PRODUCTION SYSTEM BIO-FILTRATION POULTRY & SWINE

Description:	Carbon-based filters integrated into the aeration system of poultry houses or slatted floor swine facilities to intercept ammonia as air is vented from facility.
Problem Addressed:	Current production facility aeration systems are designed to minimize ammonia concentrations in order to protect animal health. This procedure emits significant concentrations of ammonia into the atmosphere. Emissions continue throughout the production cycle. Ammonia concentrations usually increase with animal growth. This results is high local nitrogen deposition that is currently not considered during nutrient management planning. This increases the potential for over application of nitrogen on crop fields and for nitrogen leaching from all landuses and open water.
Landuse Affected:	cropland, hayland, pasture, woodland, urban, open water
Pollutant Source(s) Addressed	NEW SOURCE: Ammonia emission/deposition from swine and poultry production systems.
Issues to be addressed by grantee:	By Production System Type: - Average *annual* ammonia concentration and load leaving the production facility prior to integrating filter system. - Average *annual* ammonia concentration and load leaving the production facility after integrating filter system. - Average daily filter effectiveness. - Frequency of filter changes, especially as animal size increases, and the effect on filter effectiveness if not changed. - Condition and proper disposal of "dirty" filters.

AMMONIA CAPTURE – PRODUCTION FACILITY - VEGETATIVE FILTER POULTRY & SWINE

Description:	Vegetative barrier planted near poultry houses in the direct path of fan discharge. Intercepts high ammonia concentrations leaving the production facility, prevents or minimizes local deposition.
Problem Addressed:	Current production facility aeration systems are designed to minimize ammonia concentrations to protect animal health. This procedure emits significant ammonia concentrations into the atmosphere. Emissions continue throughout the production cycle. Ammonia concentrations usually increase with animal growth. This results in high local nitrogen deposition not currently considered during nutrient management planning. This increases the potential for increased nitrogen leaching from all landuses.
Landuse Affected:	cropland, hayland, pasture, woodland, urban, open water
Pollutant Source(s) Addressed	NEW SOURCE: Ammonia emission/deposition from swine and poultry production systems.
Issues to be answered by grantee:	By Production System Type: - Ammonia concentration and average daily load leaving the production facility prior to planting vegetative filter. - Ammonia concentration and average daily load leaving the production area after integration of filter system. - Ability of vegetation to provide reductions in winter. - Does a continuous constant flow of high concentrations of ammonia over some period of time result in a loss of intercept efficiency. - Does the impact from storm events (washing leaves) create a nitrogen "sink" within a trees drip line? - Are some tree species better "filters" than others? - What is the minimum tree size to be effective? - What are the configurations of tree stand spacing width (relative to fan), and depth which provide the maximum interception benefit?

AMMONIA CAPTURE – POULTRY PRODUCTION FACILITY
MANURE ADDITIVE (alum)

Description:	Periodic application of Aluminum Sulfide (alum) to poultry litter to suppress ammonia release.
Problem Addressed:	Current production facility aeration systems are designed to minimize ammonia concentrations to protect animal health. This procedure emits significant ammonia concentrations into the atmosphere. Emissions continue throughout the production cycle. Ammonia concentrations usually increase with animal growth. Manure additives significantly reduce ammonia release from manure, decrease ammonia vented by fans, and increase ammonia concentration in applied manure.
Landuse Affected:	N/A
Pollutant Source(s) Addressed	NEW SOURCE: Ammonia emission/deposition from swine and poultry production systems.
Issues to be answered by grantee:	By Production System Type: - Ammonia concentration or daily load leaving the production facility prior to alum addition. - Ammonia concentration or daily load leaving the production facility after alum addition. - Alum application rate and frequency. - Impact on availability/release rate of sequestered nitrogen of field applied litter.

HORSE PADDOCK MANAGEMENT

Description:	Stabilizing overused small pasture containment areas (animal concentration area) adjacent to animal shelters or farmstead.
Problem Addressed:	An area located close to a barn or shelter where animals are concentrated for feeding, watering or exercise. Area devoid of protective cover, resulting in high edge-of-field concentrations of nutrients and sediment during most rainfall events.
Landuse Affected:	Pasture
Pollutant Source(s) Addressed	NEW SOURCE: N/P/Sediment
Issues to be answered by grantee:	Pre-PRACTICE EOF of "animal concentration area" prior to PRACTICE implementation. (provide average condition based on several AU densities.) Post-PRACTICE EOF for a stabilized area. (provide average condition based on several AU densities.)

INNOVATIVE CROPPING SYSTEM (ICS)/CONTINUOUS NO-TILL

Description:	Conservation tillage involves a crop rotation and planting technique that results in reduced surface soil disturbance. Conservation tillage requires two components, (a) a minimum 30% residue coverage at the time of planting and (b) a non-inversion tillage method. Continuous no-till is an advanced form of conservation tillage in which all crops within the rotation are planted using no-till technology. In addition, it requires that a minimum 60% or greater crop residue cover be maintained at all times for a minimum of five years.
Problem Addressed:	Sediment & nutrient loss in crop fields are significantly reduced when a combination of minimum-till technology and high crop residue levels on the soil surface are employed at the time of planting.
Landuse Affected:	Conservation-till Cropland
Pollutant Source(s) Addressed	N/P/Sediment
Issues to be answered by grantee:	- Impact of ICS on nitrogen, phosphorus and sediment loads over and above the benefits derived from "normal" conservation tillage methods. - Effect of high concentrations of crop residue (carbon)and improved soil quality on nitrogen leaching (interception or acceleration). - Effect of ICS on surface phosphorus build-up and potential for increased dissolved P loss.

PRECISION AGRICULTURE

Description:	Fertilizer application methodology that combines a series of GIS based inputs, such as soil phosphorus levels (grid based soil sampling) and related yield information with a variable rate controller to vary application rates within a field. Where possible, application rates are based on historical yield information. This methodology acknowledges variation in yield potential within a crop field and adjusts nutrient application rates to match location specific yield potential. Application rates are based on nutrient management planning principles.
Problem Addressed:	Applying nutrients based on average field yield results in an over application of nutrients in some areas and an under application in others. In areas of under application maximum yield potential is not possible. Where over applied, maximum yield potential will likely under utilize applied nutrients. This results in pockets of excessive nutrients (N leaching or P buildup).
Landuse Affected:	Conservation and conventional tilled cropland
Pollutant Source(s) Addressed	N/P
Issues to be answered by grantee:	Note: References for this PRACTICE should be Chesapeake Bay Basin Specific. If none exist, outside sources are acceptable, however, affect within Basin should be evaluated. - PRACTICE Efficiency: Amount of N/P saved using PRACTICE. (value or range of values). Recommended "average" per acre reduction in application rate can be related to a county, region, state, major tributary or entire Basin. - Significant actions necessary to utilize PRACTICE. i.e. management activities, pre/post planting tests, etc. - Where possible, indicate net yield increase/decrease associated with application of this PRACTICE. - Optional: Economic considerations. i.e. minimal/optimal acreage, specialized equipment, etc.

PRECISION FEEDING – DAIRY/BEEF

Description:	Managing individual animal or herd diets to maximize milk production or animal growth using on-farm resources. Minimize off-farm purchases. Management may include monitoring milk production, feed intake (amount & type), and/or periodic feed ration analysis based on "standard" performance measurements, i.e. NRC recommendations. Dairy: Closely monitored (and adjusted) diets and milk content (butter fat), can maximize production, make efficient use of nutrients and minimize the use of feed supplements.
Problem Addressed:	Adding phytase to poultry or swine feed can produce a more efficient use of phosphorus in these species, resulting in a reduced level of voided N/P. This type of food additive does not work with dairy or beef animals.
Landuse Affected:	N/A
Pollutant Source(s) Addressed	Manure N/P.
Issues to be answered by grantee:	- Pre/Post PRACTICE nitrogen and phosphorus content of beef and dairy manure. - Significant actions necessary to utilize PRACTICE. i.e. management activities, pasture requirements, animal/diet/manure testing, specialized equipment, etc. - Optional: Economic considerations. i.e. minimal herd size, optimal/minimal pasture acreage to animal unit ratio, equipment use and purchase, etc.

MORTALITY COMPOSTERS (POULTRY)

Description:	Physical structure and process for disposing of dead poultry. Composed material combined with poultry litter and applied to cropland using nutrient management plan recommendations.
Problem Addressed:	Mortality rates in poultry houses, although not high, average 1%. Given that approximately 650 million birds are produced on the Delmarva each year, a 1% annual mortality rate equals 6.5 million birds. Until recently the normal procedure for disposing of dead birds is through burial. Burial has both health and nutrient leaching implications that mortality composters are designed to address.
Landuse Affected:	N/A
Pollutant Source(s) Addressed	Dead Poultry N/P.
Issues to be answered by grantee:	- Nitrogen and phosphorus content of bird (2.0 lb average weight). - Average volume (%) of total annual manure production used in composting process. - Total initial N/P content of materials prior to composting. (i.e. in litter and birds) - Average N/P content of compost prior to field application.

STREAMBANK PROTECTION with FENCING

Description:	Using a combination of fencing, controlled water crossings and off-site watering to eliminate (or minimize) direct animal use of a free-flowing stream.
Problem Addressed:	Pastured animals with uncontrolled access to streams often use the stream for watering and cooling. They are most likely to do this during summer or low flow conditions. Continual use results in trampled streambanks and direct manure deposition in open water. This situation increases sediment, nutrient and bacteria levels in the stream.
Landuse Affected:	Pasture
Pollutant Source(s) Addressed	N/P/Sediment

Issues to be answered by grantee:	- Pre/post PRACTICE average daily or monthly nutrient and sediment concentrations & loads in open water by season, including base flow, and storm event below area disturbed by dairy/beef cattle with unlimited stream access.
	- Relationship between in-stream N/P/Sediment loads and:
	  - Base flow/storm events.
	  - Linear feet of disturbed streambank.
	  - Average N/P/S load/L. ft.
	  - Density of animals.
	  - Associated pasture acreage.
	- Often area fenced is greater than actual disturbed area. Relationship/ratio of linear feet of disturbed streambank to total linear feet of installed fence. (one side of streambank)

STREAMBANK RESTORATION/PROTECTION in NON-URBAN AREAS

Description:	A collection of site specific engineering techniques used to stablize an eroding streambank. The objective is to prevent further streambank damage and cropland loss. These are areas not associated with animal entry.
Problem Addressed:	Correcting unstable eroding streambanks using a variety of techniques to improve water quality by reducing nutrients and sediment entering the stream.
Landuse Affected:	Cropland, hayland
Pollutant Source(s) Addressed	N/P/Sediment
Issues to be answered by grantee:	- Pre/post PRACTICE condition: average daily or monthly nutrient and sediment (concentration & load) from eroding streambanks by season and/or storm events (2, 5, 10, 25 yr).

STREAM RESTORATION/PROTECTION in URBAN AREAS

Description:	A collection of site specific engineering techniques used to stablize an eroding streambank and channel. The objective is to prevent further streambank/channel damage and property loss.
Problem Addressed:	The change in landuse from forest/ag to urban significantly changes the hydrology of a watershed. As a result, relatively minor storm events can produce surface water quantities that overwhelm established stream channels. This results in streambank erosion and channel cutting that will continue unless peak flows are reduced or streambanks/channels are protected.
Landuse Affected:	Urban
Pollutant Source(s) Addressed	N/P/Sediment
Issues to be answered by grantee:	- Pre/post PRACTICE condition: average daily or monthly nutrient and sediment (concentration & load) from eroding streambanks/channels by season and/or storm events (2, 5, 10, 25 yr)..

WATER CONTROL STRUCTURE

Description:	Areas with flat level cropland and high water tables frequently have elaborate drainage systems to lower water tables below the root zone to allow early spring planting. It has been shown that these systems can be reversed, providing irrigation water to crop fields in the dry summer months or to flood fields for wildlife habitat when outside the growing season. A side benefit from restricting water flow is the reduced transport of sediment and nutrients to open water systems. The reduction in water velocity allows sediment to settle and plants to utilize available N/P for growth.
Problem Addressed:	Extensive drainage systems are designed to maintain groundwater levels below the root zone of row crops. Unfortunately, these systems convey surface or subsurface sediment and nutrients to venerable fresh water and estuarine systems quickly, if flow is not restricted.
Landuse Affected:	Cropland
Pollutant Source(s) Addressed	N/P/Sediment
Issues to be answered by grantee:	- Average open ditch N/P/S concentration leaving an unregulated system. - Average crop acreage served by one mile of controlled open ditch. - Calculated average load/acre for N/P/S per mile of reach.

FOREST HARVEST OPERATIONS

Description:	Commercial tree harvest operations disturb ground cover, expose mineral soil, and open the forest floor to direct sunlight and rainfall. Log landings, skid trails and haul roads are the primary areas of disturbance. A system of integrated conservation practices will prevent off-site sediment impact, protect stream crossings, and neutralize stormwater runoff, provided they are installed in the proper location, meet design specifications and are maintained.
Problem Addressed:	Commercial harvest operations require the construction of haul roads, skid trails and log landings to successfully extract commercial grade timber from an area. This activity, without conservation practices, can result in serious nutrient and sediment impacts to local streams affecting water quality and aquatic habitat.
Landuse Affected:	Disturbed forest
Pollutant Source(s) Addressed	N/P/Sediment

Issues to be answered by grantee:	- Pre/post PRACTICE edge-of-field loads for N/P/S.
	- Post condition assumes all erosion and sediment control practices
	  - were installed in the proper location,
	  - met appropriate design specifications and
	  - were properly maintained for the duration of the harvesting operation.

DIRT & GRAVEL ROAD STORMWATER MANAGEMENT CONTROL

Description:	In many rural areas of the Ridge & Valley, Piedmont, and Allegheny Plateau, local (county) roads are unpaved. These roads were initially constructed as part of a logging operation and over time were integrated into the local community transportation system.
Problem Addressed:	In most cases these road are gravel or packed soil surfaces. They do not have stormwater management controls nor were they built to minimize erosion impacts to local streams during severe rainfall events. The road edge often becomes the collection point for concentrated stormwater flows resulting in gully erosion and high sediment loads to streams. Although the stormwater PRACTICEs used to address this problem are site specific, the overall objective is to minimize stormwater runoff concentration and velocity, protect areas of concentrated flow from erosion, and prevent degradation of water quality or habit in local streams.
Landuse Affected:	TBD
Pollutant Source(s) Addressed	Sediment
Issues to be answered by grantee:	- Average monthly pre/post PRACTICE sediment concentration/load from dirt & gravel roads over a range of severe weather events. (2 yr, 5 yr, 10 yr, 25 yr storm events) - Average monthly sediment load per road acre (assume 50 foot width) or load per L. ft. of road.

GROUP TWO

Current Practices

CONSERVATION TILLAGE

Description:	Conservation tillage involves the planting and growing of crops with minimal disturbance of the soil surface. Conservation tillage requires two components, (a) a minimum 30% residue cover at the time of planting and (b) a non-inversion tillage method. No-till farming is a form of conservation tillage in which the crop is seeded directly into vegetative cover or crop residue with little disturbance of the soil surface. In general no-till systems require a minimum 60% crop residue cover at the time of planting to receive full benefit.
Problem Addressed:	Traditional tillage methods included some form of inversion tillage equipment, loose soil surface and no crop residue. These conditions result in nutrient and sediment loss during moderate to severe storm events. In addition, soil surface temperatures are high and moisture levels low. Conservation tillage maintains a minimum 30% crop residue on the soil surface and does not use inversion tillage practices. This combination reduces the amount of loose surface soil and provides some protection against evaporation and high temperatures. The residue also acts as a barrier to storm event sheet flow reducing water velocity and improving infiltration. As a result, nutrient and sediment edge-of-field loss is substantially lower than under a conventional tillage system.
Landuse Affected:	cropland
Pollutant Source(s) Addressed	N/P/Sediment
Issues to be answered by grantee:	- Average long-term annual pre/post PRACTICE N/P/sediment edge-of-field load/ac and below root zone N load/ac over a range of storm frequencies (5 yr, 10 yr, 25 yr, 50+ yr) and crop residue levels (0%, 30%, 60%, 90%). - Combined EOF/groundwater load reduction efficiency for N/P/S between conservation tillage and conventional tillage at the 30%, 60% and 90% crop residue level.

COVER CROP (early/late/commodity)

Description:	Cereal cover crops reduce erosion and nitrogen leaching during the non-growing season (November-March) by locking nitrogen within the root zone and minimizing surface soil movement. The nutrients are then available the following year to the next crop. Cover crops are fall planted into crop residue with minimal soil disturbance and without nutrient application. They are not harvested. They provide organic material for improved soil quality and stored nutrients for crop use. Early Planted Cover Crops: Planted with minimum soil disturbance at least seven (7) days **prior** to the published frost date for the region. No "starter" application of commercial fertilizer or manure. Late Planted Cover Crops: Planted with minimum soil disturbance no more than seven (7) days **after** the published frost date for the region. No "starter" application of commercial fertilizer or manure. Commodity Cover Crops: Meets the criteria of early planted cover crops **except** producer decides to produce a crop. In this case spring nutrient applications are permitted after March 1. Crop is harvested in late spring. Crop residue is maintained on the soil surface the remainder of the growing season or when double-cropped.
Problem Addressed:	Nutrient applications are field specific and based on the expected yield/ac in that field. Per acre yields vary annually based on a variety of natural factors. When expected yield is not reached, the likelihood of residual nutrients remaining on the soil surface or within the root zone is high. Rain events/snow melt leaving the field as surface runoff or leaching through the soil by infiltration carry residual nutrients off-site and into open water systems. This degrades both soil productivity and off-site water quality. In addition, the loss of these nutrients to the following year's crop, translates to higher per acre production costs.
Landuse Affected:	cropland
Pollutant Source(s) Addressed	N/P/Sediment

Issues to be answered by grantee:	- Seasonal pre/post PRACTICE N/P/sediment edge-of-field and leached load/ac over a range of weather events (2 yr, 5 yr, 10 yr, storm events) for both early and late planted cover crops following corn or soybeans. (specify) - Efficiency of early and late planted cover crops compared to no-cover following corn and soybeans. - Seasonal pre/post PRACTICE N/P/sediment edge-of-field and leached load/ac over a range of weather events (2 yr, 5 yr, 10 yr, storm events) for **winter small grains** (WSG) production following corn. i.e. two-year rotation of corn-WSG-soybeans, where WSG is planted for production and starter/spring nutrient applications are applied. (specify planting method as related to sediment loss).

ROTATIONAL GRAZING

Description:	Managing the location and extent of pasture grazing to maximize its use, minimize external/supplemental feed costs, and maintain high quality nutrient rich grass throughout the pasture. Rotational grazing combines intense feeding of small areas by all pastured animals for a limited time to fully utilize available grass. Grazing location is relocated based on plant height. Areas/paddocks are not overgrazed. Water availability in all paddocks is fundamental for success. In most cases this is accomplished through mobile tanks or designing a paddock configuration that allows access to a fixed watering site.
Problem Addressed:	Grazing animals normally will not fully utilize a pasture due to several factors. These include available plant species, water availability and shade. Often this results in areas of little use and others that are overgrazed. Rotational grazing separates the pasture into a series of small areas or paddocks that are intensively grazed by all animals. Animals are moved to a new paddock prior to overgrazing. Paddocks are not reused until they have had a chance to fully recover. Often this system is used in conjunction with streambank fencing and offsite watering to minimize uncontrolled direct stream access. However, the system is not always associated with streambank fencing and can/does stand on its own as a viable practice to improve pasture surface cover and nutrient uptake.
Landuse Affected:	pasture
Pollutant Source(s) Addressed	N/P/Sediment
Issues to be answered by grantee:	- Average annual pre/post PRACTICE N/P/sediment edge-of-field load/ac and below root zone N load/ac. (If EOF loads vary considerably during/after the growing season, specify differences.) ***Pre-PRACTICE condition is assumed overgrazed.*** - Recommended efficiency. (specify annual or seasonal)

CONSERVATION PLANS

Description:	A listing of the conservation practices; engineering, agronomic, and management, that (combined) will maintain a specific level of soil quality, agricultural productivity and minimal off-site environmental impact within a crop, hay or pasture field. Although conservation planning (by definition) encompasses much more than minimizing soil movement, the objective of this PRACTICE is to describe the nutrient and sediment reduction impact from the suite of PRACTICEs designed to work together to reach and maintain an average annual soil loss of "T."
Problem Addressed:	There are a large number of conservation practices available to address soil movement, transport and loss from agricultural fields. The practices used are site specific based on site conditions, landowner operation and landuse. This situation makes it difficult to know the effect of any one conservation practice. Since conservation practices can be combined in any way to meet the individual field situation, it is not practical to establish PRACTICE efficiencies for individual field practices or combination of practices. The one item all conservation plans have in common is their objective of reaching and maintaining an average soil loss level of "T."
Landuse Affected:	Cropland, hay, pasture
Pollutant Source(s) Addressed	N/P/Sediment
Issues to be answered by grantee:	Assuming full implementation of the conservation practices specified in the conservation plan, soil loss would be reduced and maintained at "T." Plan does **not** include land retirement (CRP), land conversion (buffers, wetlands), nutrient management, or wildlife enhancement. - Average annual pre/post PRACTICE N/P/sediment edge-of-field load/ac and below root zone N load/ac over a range of storm frequencies (5 yr, 10 yr, 25 yr, 50+ yr). - Reduction efficiency for N/P/S. If conservation tillage is required but not included: - Average annual pre/post PRACTICE N/P/sediment edge-of-field load/ac and below root zone N load/ac over a range of storm frequencies (5 yr, 10 yr, 25 yr, 50+ yr). - Reduction efficiency for N/P/S.

ENHANCED NUTRIENT MANAGEMENT

Description:	Matching nutrient availability (from all sources) to crop need based on the long-term average yield. The object is to balance crop uptake with nutrient availability, resulting in zero residual nutrients. Since weather is highly variable, there may be a slight decrease in yield in any one year.
Problem Addressed:	The N/P recommendations used in nutrient management planning are approximately 30 percent higher than needed to meet crop need. This is done to ensure nutrient availability as the plant grows. Under average growing conditions and average yield, approximately 30% of the applied nutrients will not be utilized by the crop. In exceptional years yields will increase until available nutrients are depleted. In drought years, residual nutrients will be greater than the expected 30 percent. Residual nutrients will likely leave the field prior to the next growing season either through leaching or surface runoff, assuming no use of cover crops. This condition aversely impacts off-site water quality and nutrient costs the following year. Matching crop uptake with available nutrients (from all sources) based on the long-term average yield, assumes an accurate estimation of residual (in soil) nutrients and crop uptake rate (yield). Under-estimating either condition will result in a yield loss for that year. For this reason some type of incentive or crop (yield) insurance is likely necessary to offset the risk of yield loss.
Landuse Affected:	Cropland, hay, pasture
Pollutant Source(s) Addressed	N/P
Issues to be answered by grantee:	- Impact on <u>long-term</u> average yield when reducing nutrient applications to a point below nutrient management levels, i.e. matching estimated crop need to estimated nutrient availability.

WETLAND CREATION/RESTORATION/ENHANCEMENT

Description:	Areas of poorly drained soils that have standing surface water or very high water tables all or part of the year. These areas vary in habitat (grass to trees), wildlife and nutrient/sediment filtering capacity. Often wetlands are not stand alone entities, but the intermediate zone between open water systems (streams, lakes, estuary) and dry land areas. These areas provide critical habitat for many resident and seasonal wildlife as well as a buffer area in times of intense rainfall events, reducing peak flows to open water or providing flood control within the open water system itself.
Problem Addressed:	Wetlands that are created (new location), restored (re-establishing prior hydrology) or enhanced (changing wetland type) have the ability to filter nutrients and sediment from water prior to its release into an open water system. The reduction efficiency of a wetland as a filtering agent varies with season, vegetation and water retention time.
Landuse Affected:	Cropland, hay, pasture
Pollutant Source(s) Addressed	N/P/Sediment
Issues to be answered by grantee:	- Average **seasonal** pre/post PRACTICE N/P/sediment edge-of-field load/ac for a sampling of wetland types. EOF loads in this case are more likely inflow/outflow. - Results should include as minimum, one grass and one forested wetland example. - Recommend best option for applying the wetland PRACTICE in the watershed model. Options include (but not limited to): (1) one EOF description or efficiency that averages all wetland types and seasonal differences, (2) seasonal variation within an average wetland, i.e. option 1 including seasonal differences, (3) seasonal variation within two or three general wetland categories. (Examples: grass, forested, mixed vegetation)

FOREST BUFFERS

Description:	Mature stands of trees with well developed root systems, organic surface layer and understory vegetation located adjacent to open water. These areas provide multiple benefits, including wildlife habitat, water quality improvement, and temperature control. The wider the buffer, the greater the variety and the higher the quality of those benefits. The recommended minimum width is 100 feet.
Problem Addressed:	Areas along streams receiving forest buffers are assumed to provide multiple benefits regardless of the state of the landuses adjacent to them. In addition, the type and frequency of buffer maintenance to ensure full utilization of the buffer's filtering/interception capabilities is not widely known.
Landuse Affected:	cropland adjacent to streams and wetland areas
Pollutant Source(s) Addressed	N/P/Sediment
Issues to be answered by grantee:	- Average seasonal pre/post PRACTICE N/P/sediment edge-of-field load/ac and below root zone N load/ac over a range of storm frequencies (5 yr, 10 yr, 25 yr, 50+ yr) and upland land cover conditions. i.e. cropland without proper conservation practices resulting in concentrated flow entering the buffer. - Effectiveness of buffer to filter nutrients or sediment if concentrated flow is allowed to develop along its length. (poor maintenance) - Efficiency of a forest buffer the year planted. Years after planting that full EOF reductions occur. - Affect of buffer width on efficiency.

WET PONDS

Description:	A water impoundment structure that intercepts stormwater runoff then releases it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. Until recently, these practices were designed specifically to meet water quantity, not water quality objectives. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Nitrogen reductions is minimal.
Problem Addressed:	Historically, stormwater management has concentrated on water quantity i.e. peak flow management, not water quality. In general, stormwater wet pond designs did not offer mechanisms (retention times, shallow water depths) for significant water quality reduction. In many cases these systems, due to design features (expansion limitations, steep interior sideslopes), are not easy candidates for retrofits.
Landuse Affected:	urban
Pollutant Source(s) Addressed	N/P/Sediment
Issues to be answered by grantee:	- Average annual inflow/outflow N/P/S loads over a range of storm frequencies (5 yr, 10 yr, 25 yr, 50+ yr). - Examine relationship of N/P/S reductions to residence time.

DRY DETENTION & EXTENDED DETENTION PONDS

Description:	A water impoundment structure that intercepts stormwater runoff then releases it to an open water system at a specified flow rate. These structures are dry when not in use. Retention times may be sufficient to allow settlement of some intercepted sediment and attached nutrients/toxics. These practices are designed specifically to meet water quantity, not water quality objectives. There is little or no residence time, beyond that need to meet release requirements. Vegetation may be living within the pond interior, but is completely flooded during a rainfall event. It is unclear if intercepted sediment is resuspended in the next storm event or if there is a permanent reduction in total release. Nitrogen reductions is minimal.
Problem Addressed:	Historically, stormwater management has concentrated on water quantity i.e. peak flow management, not water quality. In general, stormwater dry pond designs do not offer mechanisms (retention times, shallow water depths) for significant water quality reduction, as built. These systems may have potential for retrofit.
Landuse Affected:	urban
Pollutant Source(s) Addressed	N/P/Sediment
Issues to be answered by grantee:	- Average annual inflow/outflow N/P/S loads over a range of storm frequencies (5 yr, 10 yr, 25 yr, 50+ yr). - Examine relationship of N/P/S reductions to residence time. - Analysis of sediment retention. Is sediment re-suspended and lost with the next storm event or permanently eliminated from open water system.

EROSION & SEDIMENT CONTROL ON CONSTRUCTION SITES

Description:	A site specific set of conservation practices designed to minimize off-site impacts from land disturbing activities under light ot moderate storm events.
Problem Addressed:	Land conversions from any land cover type to urban disturbs the soil surface, making it susceptible to erosion. Any rainfall event is likely to have an off-site water quality impact. E&S controls mimimize this impact as long as practices are properly chosen for the situation, installed according to an approved design, and checked, repaired or replaced after each storm event.
Landuse Affected:	urban
Pollutant Source(s) Addressed	N/P/Sediment
Issues to be answered by grantee:	- Average **pre-E&S Control** N/P/sediment edge-of-field load/ac (surface runoff) over a range of storm frequencies (5 yr, 10 yr, 25 yr, 50+ yr). - Average **post-E&S Control** (proper installation and maintenance) N/P/sediment edge-of-field load/ac (surface runoff) over a range of storm frequencies (5 yr, 10 yr, 25 yr, 50+ yr). - Pre/post PRACTICE particle size distribution. - Recommended efficiency for erosion & sediment control.